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Discussion of So-Called "Architectural Heritage DNA" via a Case Study of the Conservation of the Nara Palace Site, Japan

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Abstract: This study introduces a brief history of the discovery of and conservation efforts to preserve the Nara Palace Site in Japan, which brought about the recognition of this heritage site as a World Cultural Heritage location by UNESCO in 1996. Accordingly, the 1994 Nara Document on Authenticity plays an important role in contributing to Japanese cultural heritage conservation achievements, with the expansion of cultural diversity and heritage diversity and the concepts of values and authenticity, which proposed a new orientation in terms of awareness and openness to develop a broader vision when identifying architectural heritage values. Against this background, we first discuss the newly proposed concept of so-called "architectural heritage DNA" and its potential structure, providing a simple formula for appraising the authentic values of architectural heritage conservation works. Working within conservation theory, besides the doctrinal study of the 1994 Nara Document on Authenticity, this study also focuses on other important international conventions, such as the 1964 Venice Charter and the 1999 Burra Charter, to clarify the concepts of conservation, restoration, and reconstruction, adding the concept of inheritance between conservation and development, which addresses the lack of international conventions regarding cultural heritage conservation. The viewpoints expressed in this paper are based on the most common concepts of these international conventions but are interpreted in a novel, understandable, practical, and highly applicable approach suited to both the current socio-political situation and future scenarios.

Keywords: authenticity; Nara Palace site; 1994 Nara Document; architectural heritage DNA; conservation; Japan

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1. Introduction

1.1. Brief History of the Pre-Nara Period and the Establishment of the Nara Palace Site

Japan's territory consists of four main islands; the northernmost region is Hokkaido, the central area is Honshu main island, and the southern region comprises Kyushu and Shikoku. These four islands are divided into eight regions, grouped according to geographical and cultural characteristics from north to south, comprising Hokkaido, Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu, of which Kansai (ancient name: Kinki) is located in the south of Honshu main island, which includes the Nara district today (Figure 1). The southern area of the Kansai region has a peninsular climate, with an average temperature of 15 degrees Celsius and an average annual rainfall of 1200–1300 mm per year, while the northern area has the Odaigahara plain, which is characterized by a mountainous climate, with an average temperature of 10 degrees Celsius and an average annual rainfall ranging from 2500 to 3000 mm per year.

The Nara (奈良) area has a long history in Japan, possibly starting from the Yayoi era (2nd century BCE–3rd century CE) [1]. This area was reclaimed, settled, and developed by humans for agricultural production on a large scale. Next, at the beginning of the Kofun period (300–710 CE), a center of political power was formed and developed in this area. By

the 4th century CE, the area had developed into a major center of political power, in the form of a confederated state known as Yamato Japan (this political center was in the area of the present-day Nara district). During this period, Yamato Japan's territory only included the Kyushu and Kansai regions (except for Kanto, Tohoku, and Hokkaido). In the 6th century CE, a new national center, representing Japan's first organized political community led by a government, was established (known as the Yamato Court) in the Asuka district, located on the northern side of the Nara area. This period is known as the Asuka period (5th century—645 CE), according to the accepted divisions of Japanese history [2].

Figure 1. Location of the Nara area.

Starting from this period, Chinese civilization and Buddhism spread widely throughout Japan, creating strong technological development and profound changes in political institutions and social structures. A new government was created with a national administrative management system following the Chinese model that functioned under the Emperor's aegis known as Tennou (天皇). This important historical situation created an economic and political foundation for the establishment of the ancient Nara capital city (710–784 CE). The Tennou had to frequently move the capital to protect imperial power, avoiding the control of other political forces that had gradually emerged from influential families in Japanese society at that time. However, those families eventually seized power and took control of the entire country. Two powerful families appeared during these periods, including the Soga family (Kofun period) and the Fujiwara family (Nara and Heian periods) [3]. The Tennou lost their political power and gradually became a cultural and religious symbol of the nation. However, the great Prince Shotoku (574–622 CE) appeared after Empress Suiko had ascended to the throne as the first Queen of Japan (593 CE). Prince Shotoku took over political power as regent and became an important political leader of the country, exerting great influence in Japanese society. He played an important role in bringing Chinese civilization to Japan and promoting Buddhism; he wrote 17 articles on ethics and the basic political principles of the first constitution of Japan. Concurrently, Confucianism and Taoism were officially disseminated in Japan during these periods.

Later, Kanzi (old Chinese) characters (漢字) were introduced to Japan and became the official writing system, and coins using the Chinese model were issued, along with the establishment of national transportation systems by horse, public markets and a school system following the Chinese model, while the development of agricultural techniques brought abundant material wealth to the society. Japan became a prosperous country, and its territory was expanded north and south (except in Hokkaido and Okinawa). During these periods, Japan sent out envoys and set up an embassy in China, with the intention of expressing admiration for the Chinese Emperor and absorbing Chinese civilization into Japan.

Around 710, Japan's first large-scale Heijokyo capital city (平城京, the "Nara Palace Site") (Figures 2 and 3) was built, copying the model of the Chinese Chang'an capital city (長安京, Tang dynasty, 618–907 CE) and adopting many distinctive features of the feng shui-oriented capital city. The length of the north and south sides was 4.2 km and the east and west sides were 4.7 km [4]. In the 740s, after the political upheaval caused by the Fujiwara family, the capital was moved to the Kuni area. Around 744, due to religious reasons and for the suppression of other political powers, the capital was again moved to the Naniwa area. Around 745, due to the impact of negative feng shui, the capital was moved back to its old location in Nara and remained there until around 784, before it was moved to the Nagaoka area. Around 794, the capital was again moved to the Heian area (modern Kyoto) (Figure 4) and remained there for more than a thousand years [5].

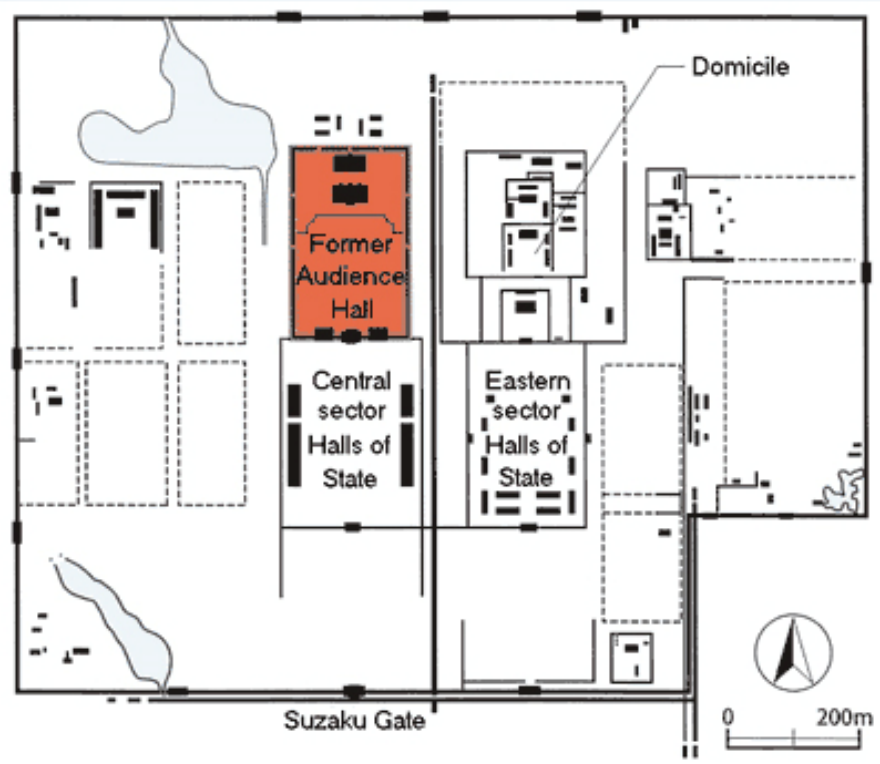

Figure 2. An image showing the scale of the Nara Palace Site (source: https://archaeology.jp/sites/2009/01heijo.htm (accessed on 18 December 2023)).

The Nara period in Japan was a short but volatile historical era that left behind a huge amount of cultural property across the country. Most of the related sites have been recognized by UNESCO as deserving of World Cultural Heritage status or are classified by the Japanese government as particularly important national heritage, such as the Toudaiji pagoda (東大寺, 760 CE), Houryuji pagoda (法隆寺, 607 CE) (Figure 5), Toshodaiji pagoda (唐招提寺, 710 CE), Koufukuji pagoda (興福寺, 685 CE), and Yakushiji Pagoda (薬師寺,

718 CE). This is especially true of the Nara Palace site, with its outstanding conservation achievements and reconstruction of Japanese architectural heritage.

Figure 3. A 3D computer graphic visualizing Nara's imperial city (source: Nabunken, 2004).

Figure 4. The movement of Nara's capital city in the Yamato region (source: https://archaeology.jp/sites/2009/01heijo.htm (accessed on 18 December 2023)).

Figure 5. The Houryuji pagoda (法隆寺, 607 CE).

1.2. Discovery of the Nara Palace Site

Nowadays, the Nara Palace site is part of Nara City, where the court's political power and the imperial residence were concentrated during the Nara period (710–784 CE), occupying an area of about 1/16 of the total area of Nara's ancient capital city. Around 1916, Professor Sekino Tadasu (1867–1935) of the University of Tokyo began to survey the area of the Nara Palace site to find traces of the above-mentioned historically famous Heijokyu capital city. Randomly, he had received information from farmers about a hill called Daigoku, which reminded him of the historically recorded main palace of the Heijokyu as Daigokuden (大極殿). Then, in 1918, he conducted a probe excavation and discovered the first big basement stone of the Daigokuden [6]. Around 1923, a small-scale archaeological survey conducted by professors and archaeologists determined the exact location of the Nara Palace site. Probably at the same time, around 1912, Professor Ito Chuta (1867–1954) [7] of the University of Tokyo began to study ancient heritage buildings in Nara City, with a focus on the remaining Horyuji pagoda and the history of the Nara period. Although his research did not focus directly on the Nara Palace site, he made important and fundamental contributions to our understanding of the ancient Japanese architectural heritage and imparted important information about the history of the Nara periods, greatly contributing to the later reconstruction of the Nara Palace site.

Until around 2004, more than 130 hectares of farming land were surveyed and nearly 1/3 of that area was archaeologically assessed, including the foundations of the most important heritage buildings of the site. According to the topographic measurement and analysis results, the Nara Palace site had north and south sides of 1250 m and east and west sides of 1000 m. Because the site is located in the basin near the foot of the mountains, the terrain is flat but has a rather steep slope in a northeast–southwest direction. The alluvial soil layer in the south area is up to 3.5 m in depth, then in the north area, it is thin; the depositional formation only appears as the lower layer of the present ground level. However, on average, in the central area, the ground level of the Nara period is about 0.80 m lower than the present level [8].

In the late 1950s, a local railway company established an investment project and chose the southern area of the Nara Palace site for infrastructure construction. This project has met with fierce opposition from professors and researchers, who have repeatedly submitted petitions to the Japanese government requesting that they cancel the project and offering a long-term plan to protect this important heritage site. In the early 1960s, Professor Ota Hirotaro of Tokyo University (a student of Professor Ito Chuta) presented his objections directly to Prime Minister Ikeda Hayato (1960–1964) [9] of Japan at that time about

the issue of the Nara Palace site, after which Prime Minister Ikeda Hayato decided to buy back the land comprising the area of the Nara Palace site, which has officially been under the management of the Japanese nation since the 1960s.

2. Literature, Study Purposes, and Methods

2.1. Literature Review

No previous papers have been published by scholars concerning this study topic. Thus, this study is mainly based on the research reports of the Japan National Cultural Property Research Institute in Nara (the "Nabunken"), such as: "Architectural studies on the Reconstruction of Suzakumon (Scarlet Phoenix Gate), Nara Imperial Palace", "Nara Heijo Imperial Palace Site Conservation Report I", "Nara Heijo Imperial Palace Site Excavation report IX", the "Brief of the Nara National Cultural Properties Research Institute, 1996–2001", the document "Conservation of Archaeological Objects—Current Environment of Conservation Science in Japan" of Takayasu Koezuka and Masaaki Sawada, the catalog of the Nabunken in 2001, etc.

Additionally, there are three international conventions addressing topics closely related to this study that have been referenced, including the 1964 Venice Charter, the 1994 Nara Document on Authenticity, and the 1999 Burra Charter. These sources of documents provide the core concepts anchoring the field of cultural heritage conservation to a global legal framework. Those documents provide both the practical experience and doctrinal knowledge needed to conduct this study.

2.2. Study Purposes and Methods

The purpose of this study is to understand the Japanese approach toward the conservation of cultural heritage and its connotations. Normally, at first sight, the Japanese method of conservation and the reconstruction of architectural heritage is characterized by the phrase "always renewable and always authentic", which is difficult to accept because of the precedent provisions mentioned in the above-referenced international conventions. However, due to the characteristics of Japanese wooden architectural heritage, restoration work to maintain the existence of this heritage is necessary. Accordingly, the necessity of replacing decayed wooden timbers with new ones is a question of force majeure; if this replacement process is repeated frequently, over time, a building will lose the original value of its heritage. In addition, the reconstruction of the ancient wooden heritage buildings of the Nara Palace site is part of an extraordinary new technique that has not been attempted before. Learning and applying an advanced conservation methodology and sharing their experience with the community are the tasks of the conservation experts, which is also the purpose of conducting this study.

Architectural heritage conservation is a practical science that combines many different fields of study, such as history, culture, archaeology, architecture, construction, and fine arts; therefore, it needs to be established concurrently with several different approaches. This study documents a special case of applied methodology that is a combination of studying historical documents, investigating conservation reports, archaeological site surveys, practicing on the restoration sites, and comparative observation between the conservation works of Vietnam's heritage sites (the Complex of Hue monuments) and Japanese's heritage sites (the Nara Palace site).

Having had the pleasure of participating in training courses sponsored by JICA (Japan International Cooperation Association) and the internship programs organized by the Laboratory of the History of Architecture (Waseda University, Japan) the author of this paper had the chance to practice his skills at the Nara Palace site (1997, 2004, and 2006) to understand the excavation works, learn about the architectural features and the reconstruction methodology, visit the restoration site of the Sakanoke family's traditional house (2005) to learn about investigation methods regarding wooden structures and the trend of transformation, visit the restoration site of Toushodaiji (2006) to understand the dismantling restoration method of wooden architecture and practicing on the technique of carbon-

copy of the caved decoration on timbers, visit the Takenaka Dougukan museum (2007) to get to know the Japanese traditional carpenter's tools and the relevant techniques, and attend study tours of the famous cultural heritage sites in Japan to understand Japanese conservation methodology and conservation policy. In addition, the author performed a self-doctrinal study of the international conventions and lectures from Japanese master artisans, such as the architect and master carpenter Takaka Fumio, Satoh's traditional lacquer family, and the conservation experts of the Nabunken. These activities provided materials, knowledge, and experiential experience that helped the author conduct this study.

3. Case Study of the Conservation of the Nara Palace Site

3.1. Preservation of Archaeological Sites

The archaeological excavation at the Nara Palace site has opened the door to a mysterious and legendary historical period that covered more than 1200 years, making an important contribution to the regeneration of the ancient history of Japan (Figures 6 and 7). Accordingly, thousands of archaeological artifacts of various types, tools, thousands of pages of ancient documents, and a hundred remaining original timbers have been discovered and preserved scientifically, which has been very useful in helping historians, architects, and scientists to understand the history of the Nara period, providing important knowledge regarding the study of conservation and the reconstruction of the Nara Palace site.

Figure 6. Archaeological excavation site of the Touinteien East Palace Garden (source: Nabunken, 2004).

Two general solutions have been proposed and implemented in sequence. The first is a plan to change the archaeological site into a relic park according to the site-planning model of the ancient capital city, although reconstruction projects have not been implemented. The second is restoring the historical appearance when sufficient evidence has been collected, doubts have been clarified, and reconstruction of the selected important heritage buildings can commence.

In the case of archaeological foundation ruins, a modeling method is applied. The modeling method can be understood as the visualization of information and knowledge about the ruins, related to each architectural entity or a complex of foundation ruins, using hypothetical models. Even large archaeological sites can be modeled to preserve the integrity of the knowledge and retain archaeological evidence for future reference.

For large complexes containing heritage buildings, the visualization of hypothetical research results using full-scale models is very useful for analysis that cannot be performed via 2D drawings or 3D computer graphics. These full-scale models are placed right above the foundation's ruins at their original location, this solution proved quite effective in as-

sisting in visualizing the overall planning of the Nara Palace Site (Figure 8). For the ruins of imperial residences, 1/50 scale models are applied for visualization (Figure 9).

The remains of other objects discovered during the excavation, whether they were part of the architectural components, such as timber, basement stones (not located in their original position), bricks, and tile fragments, or archaeological artifacts (Figure 10), were relocated to newly designated gathering places for research, storage, and display [10].

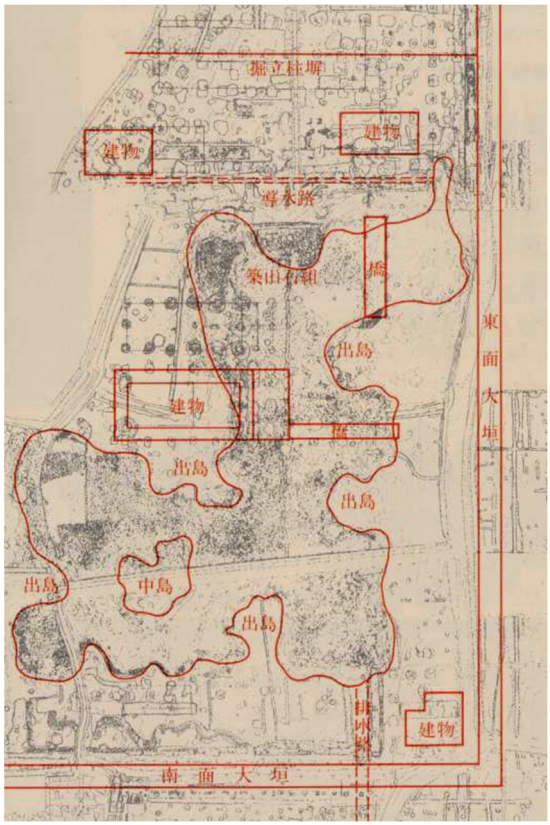

Figure 7. Archaeological drawing of the Touinteien East Palace Garden (source: Nabunken, 2004).

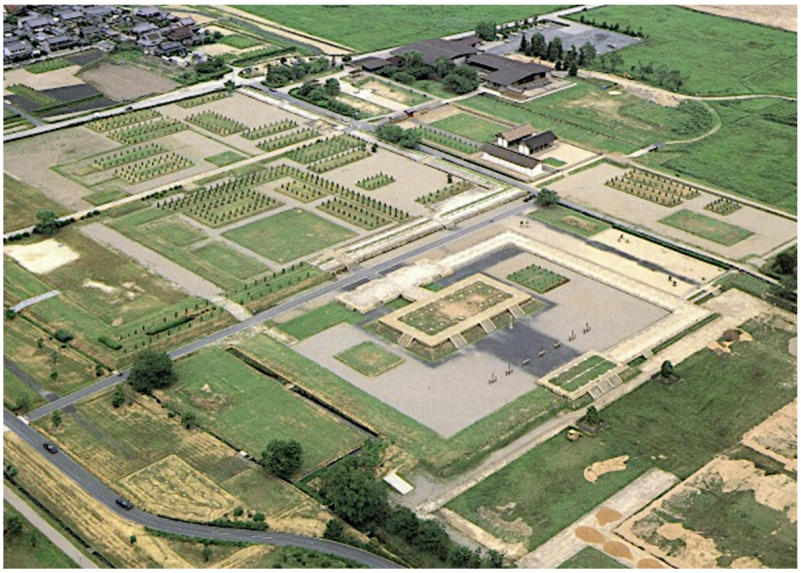

Figure 8. The 1/1 scale reconstructed model of the central area of the Nara Palace site (source: Nabunken, 2004).

Figure 9. The 1/50 scale reconstructed model of the imperial residence at the Nara Palace site (Nara, 2022).

Figure 10. The archaeological artifacts that have been relocated to the Nara Palace Site Museum (Nara, 2022).

3.2. Comprehensive Research Activities

Normally, comprehensive research can be clearly distinguished from site surveying, which is also included in restoration projects. The outcome of these comprehensive studies will be fuller knowledge of the heritage site and an objective assessment of the site's heritage value. The comprehensive research conducted at the Nara Palace site will include the activities below.

3.2.1. Historical Document Studies

All the historical sources (including official historic documents, ancient inscriptions, old drawings, and, possibly, previous study reports) should be thoroughly investigated and cataloged. These works are aimed at determining the existence of heritage buildings, their construction history, modification or/and transformation through previous restoration or renovation activities, symbolic meaning, and the use of heritage buildings (Figures 11 and 12).

Figure 11. De-coding of historic documents (source: Nabunken, 2004).

Figure 12. Analyzing the relics and historical sources using advanced equipment (source: Nabunken, 2004).

Through a study of the historical sources, the architectural chronology and its authentic features will be truthfully re-drawn. On that basis, this process will help conservation experts to make a trustworthy and accurate assessment of heritage values and draw up a suitable plan for reconstruction projects that will give back the highest value according to its golden age. In addition, these historical studies will help to build comprehensive records of heritage buildings for future stages of conservation.

3.2.2. Archaeological Studies

Archaeological studies are applied to the structure at an underground level. When understood in a larger sense, the structure underground can be considered to be the whole of the ruins found at archeological sites, while in a narrow sense, the term can only be considered to apply to the underground parts of the foundation of heritage buildings. These provide very important physical pieces of evidence that prove the existence of heritage

buildings in their original locations, and/or as information indicating changes in their physical structure through previous renovations. When a change is found in the underground structure, it is a sign of strong intervention in the physical structure of the heritage building, thereby affecting the structure above the ground through changes that can be seen (Figures 13–15).

Figure 13. Ruins of the wooden structure of a corridor laid out at the archaeological site (source: Nabunken, 2004).

Figure 14. Ruins of the wooden pillar in its primary location (source: Nabunken, 2004).

3.2.3. Studies on Traditional Design Principles and Methods

Traditional design methods are an original and intangible source of heritage value. Therefore, the authentic designs, in this case, should be approached and understood in terms of larger concepts, not merely as geometrical sketches that specify dimensions and pure architectural language characters but as formulas encoded in the various architectural forms. Conservation experts need to learn the know-how and the mechanisms that create heritage buildings and their values, thereby providing useful guidance for restoration and/or reconstruction solutions to conserve or give back as much as possible of the authentic value of the heritage (Figures 16–18).

Figure 15. Ruins of the wooden columns (source: Nabunken, 2004).

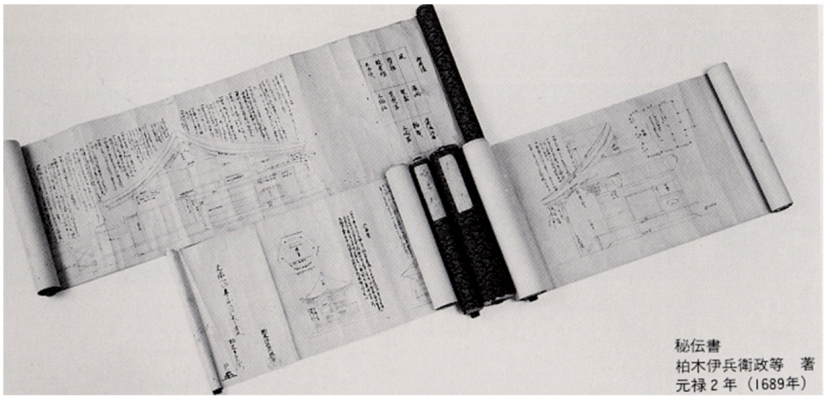

Figure 16. The "Kiwari shou" old carpenters' manuals (source: Nabunken, 2004).

Figure 17. Decoding traditional design methods, based on old carpenters' manuals.

Figure 18. Re-prototyping of the timbers according to old carpenters' manuals.

In an ideal case, the authentic designs of the heritage buildings are still handed down and can be found; however, these design methods are often handed down by experience through trial and error and are passed from generation to generation or via formulas encoded in a particular way by each ethnic community, in which traditional families of carpenters and artisans are often the repository of such experiences. In some cases, their wording or working procedures do not match contemporary scientific logic, yet the knowledge they impart through history is superior, programmed to create the appropriate architectural style and generate heritage value.

3.2.4. Studies on Traditional Construction Techniques and Authentic Materials

The application of traditional construction techniques and the use of authentic materials are prerequisites to ensure the authenticity of architectural heritage throughout restoration activities (Figures 19–24). Therefore, before intervening to conserve a heritage building, it is necessary to understand how the heritage building was built, from what materials it is made, and how the physicochemical properties can be used in suitable consolidation solutions.

Figure 19. An old painting showing Japanese traditional carpentry (source: Takanaka Dougukan).

Figure 20. Traditional Japanese carpentry tools (source: Takanaka Dougukan).

Figure 21. Testing authentic wooden relics from the Nara Palace site (source: Nabunken, 2004).

It is dangerous to apply more recent construction techniques and use alternative materials to those used in the original version of the heritage building since these techniques and materials have not been proven in terms of time, possibly leading to degradation or rapid collapse. The most important issue is that the meaning and purpose of the restoration and conservation of architectural heritage will not be achieved if the elements constituting the building's heritage value are omitted or distorted. The original value and authenticity of the heritage will gradually be lost due to ignorant restoration activities and a lack of careful consideration in the application of construction techniques and alternative materials. In terms of the Japanese conception of restoration, which will be mentioned in the next chapters (Section 4.2), using the same materials as in the original (authentic materials) and applying traditional construction techniques during restoration and/or reconstruction works are obligatory.

Figure 22. Using authentic materials (Hinoki wood) and traditional carpentry tools to recreate the historical aspect of replacement timbers (Nara 2006).

Figure 23. The replacement timbers are assembled in their final positions using traditional techniques (Nara 2006).

Figure 24. Using authentic materials for the roof tiles when re-roofing heritage buildings (Nara 2006).

3.2.5. Experimental Model Study

This technique existed in the past as a way to visualize the intention of an architectural design using a model (made of fired clay, wood, or metal) to express the features and structure of the intended buildings. However, this method is gradually being forgotten, due to the overwhelming use of computer graphics today (such as AutoCAD, Revit, V-Ray for 3ds Max, Unreal Engine, etc.) with 3D images that are very convenient for observing the three-dimensional spaces of architecture. A design method using a real model helps to directly verify the feasibility of load-bearing structures and construction methods. This method is especially important for wooden heritage buildings because the timbers are fixed together using traditional tenon methods, which work together continuously to transmit force and suppress adverse forces to help the heritage building achieve structural stability and aesthetic balance. The experimental model study method offers a way of using trial and error, in case the design is not optimized; this model can be disassembled in further research to overcome weaknesses in the design (Figures 25 and 26).

Usually, the appropriate model scale will be 1/200 or 1/100 for the study of site planning principles or for a group of heritage buildings, 1/20 or 1/10 for architectural study, 1/5 for structural study, and 1/1 for the study of decorative patterns carved on wood or painted murals. Thus, the use of experimental models in the restoration of architectural heritage is like creating first drafts to avoid technical errors that may be encountered during the restoration process.

Figure 25. The remaining original 1/5 scale design model (a small five-floor tower) of Kairyuouji Pagoda, Japan.

3.2.6. The Heritage Historical Environment and Retained Sporophyll/Pollen Studies

Architectural heritage is always placed in a natural environment that is organically associated with its value. In terms of physical impact, humidity, wind, and heat will directly affect the material expansion of heritage buildings. In terms of natural effects, active substances in the air and plant pollen spores will have interactions with architectural materials, with negative impacts. Therefore, a full understanding of the heritage site's surrounding environment and the sources of wooden materials is necessary to generate effective solu-

tions to improve the technical conditions of the heritage building and limit negative impacts on the existence of that heritage building.

Figure 26. The experimental 1/5 scale-reconstruction model of the Daigokuden Imperial Audience Hall on the Nara Palace site (Nara 2022).

In addition, the surrounding natural environment also plays an important role in regenerating architectural landscaping around the heritage building, which is related to the heritage's constituting values. The colors of flowers and leaves, the height and cover of the tree canopy, and the shaded areas are also important factors that directly affect heritage landscaping (Figures 27 and 28).

Figure 27. A historical environment, displayed on an old painting (source: Nabunken, 2004).

Figure 28. Studies of the remains of sporophyll/pollen (Source: Nabunken, 2004).

3.2.7. Publishing the Restoration and Reconstruction Reports

Publishing reports after the restoration project is complete is not merely a matter of as-built records for the payment and settlement of accounts. Restoration projects dealing with heritage buildings are completely different from new architectural construction projects, but most of the processes and conditions for making payment and settlement are subject to the type of construction work involved, leading to trivialization of the restoration and reconstruction of heritage buildings. Restoration and reconstruction document storing, database digitalizing, and publishing reports can bring long-term benefits regarding the future conservation of architectural heritage. First, it provides a summary of theoretical and practical experience; second, it creates a valuable legacy in the form of a scientific record with a lasting reference value; third, it is the legal basis for the payment, settlement, and disbursement of investment funds for the restoration and preservation of heritage buildings (Figure 29).

Figure 29. Printed versions of the restoration report along with tapes holding the video recordings.

3.3. Reconstruction of Heritage Buildings

Reconstruction studies and reconstruction projects are different. Reconstruction projects must be based on proven reconstruction study results. These reconstruction studies yield a richness of information that is important not only for the current project but also for many other reconstruction projects. In other words, a reconstruction project is begun as a consequence of reconstruction studies. In the field of architectural heritage reconstruction, an understanding of construction history, archaeological evidence, authentic materials, and traditional techniques must be the first of many necessary and sufficient conditions; the next would be other fully available authentic document resources that make it possible to carry out reconstruction projects recreating lost heritage buildings.

By using a method of comparative analysis on existing synchronous and similar heritage buildings, which date back from the same Nara period mentioned above, and based on the revealed archaeological foundation, it is possible to determine the column spans and column diameter. The researchers analyzed and compared the architectural proportions between the ruins of these foundations and the existing synchronous and similar heritage buildings, thereby predicting the upper structure of the lost heritage buildings to be reconstructed. The design unit used to analyze was the traditional measurement unit of Japan, known as a saku (1 unit = 29.5 cm) [11].

Reconstruction works have been carefully carried out, based on the following main stages: researching historical documents and related information, conducting an archaeological study of the remaining foundations, analyzing the architectural proportions, studies of the traditional design method and construction techniques, carrying out the architectural and engineering design, 3D computer modeling, building experimental research models (1/20, 1/10, 1/5 scale), material and structural testing, promoting reconstruction work, and the publication of scientific reports. The full-scale model can also be considered as a reconstructed heritage building (Figures 30–37).

It is difficult to give an accurate assessment of the authenticity of these reconstructed heritage buildings, but with one of the most important original constituents that was identified as an archaeological foundation at its original location, and the full knowledge of traditional construction techniques applied in the time frame of the Nara period, the reconstructions were appraised and were considered to meet authenticity standards according to the above international conventions.

Figure 30. The full-scale reconstructed model of the Suzakumon Scarlet Phoenix Gate (Nara 2022).

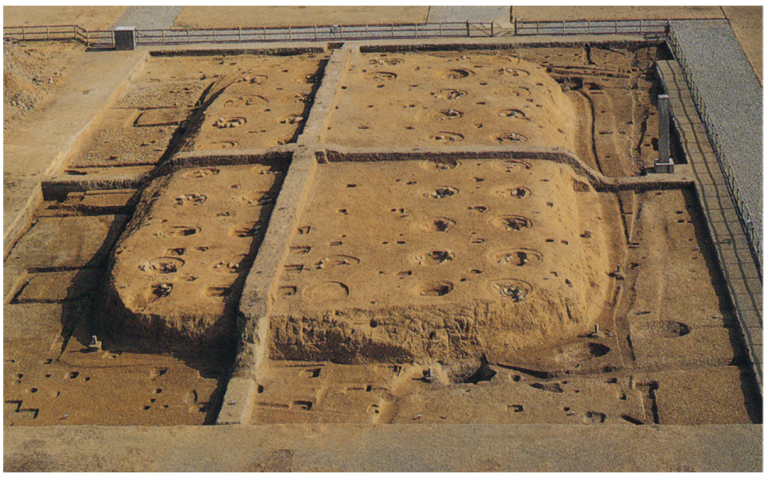

Figure 31. Ruins of the Suzakumon Scarlet Phoenix Gate's foundations (source: Nabunken, 2004).

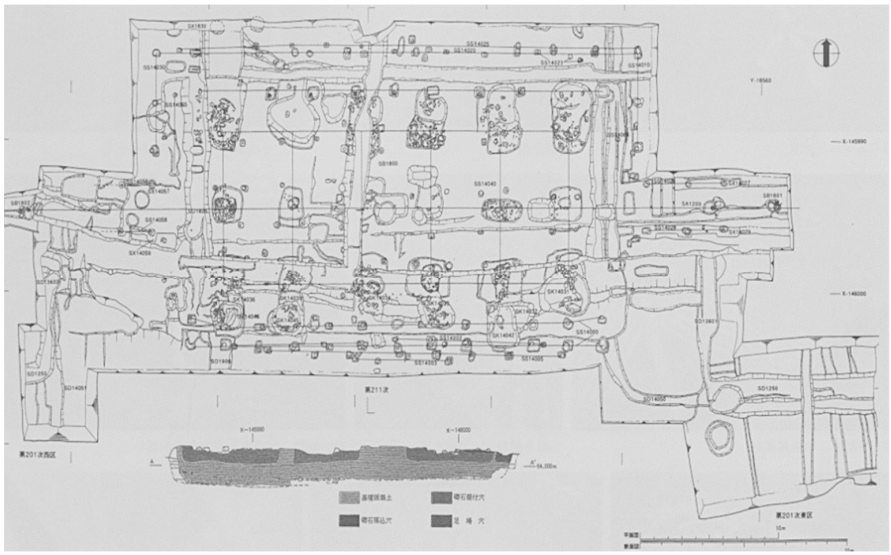

Figure 32. Archaeological drawing of the Suzakumon Scarlet Phoenix Gate's foundations (source: Nabunken, 2004).

Figure 33. The full-scale reconstructed model of the Suzakumon Scarlet Phoenix Gate's foundations (source: Nabunken, 2004).

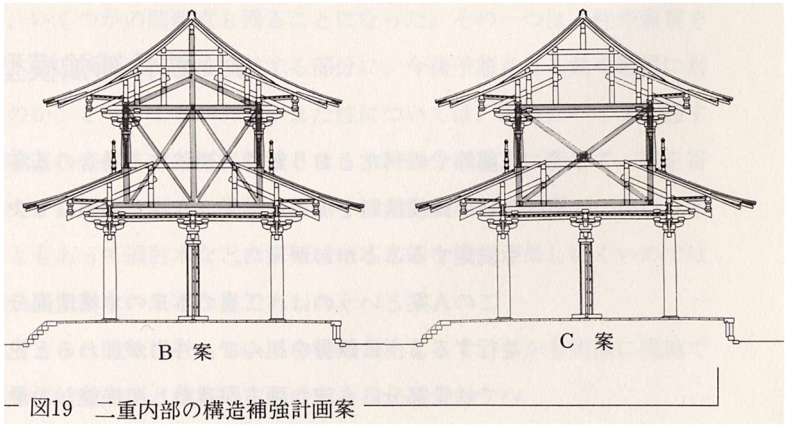

Figure 34. Optional reconstruction designs of the wooden structure of the Suzakumon Scarlet Phoenix Gate (source: Nabunken, 2004).

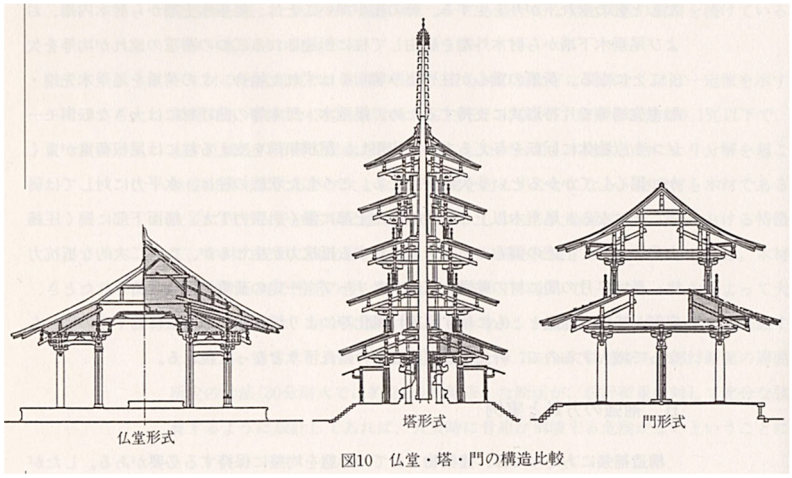

Figure 35. Comparative analysis of the wooden structure for the reconstruction of the Suzakumon Scarlet Phoenix Gate (source: Nabunken, 2004).

Figure 36. The 1/10 scale reconstructed model of the Daigokuden Imperial Audience Hall.

Figure 37. The full-scale reconstructed model of the Touinteien East Palace Garden.

Thus, after nearly 100 years of research and the accumulation of knowledge, it was not until the last years of the 20th century that the Japanese began reconstruction work on the Nara Palace site. Accordingly, important heritage buildings have now been reconstructed, such as the "Suzakumon" Scarlet Phoenix Gate (朱雀門), the "Daigokuden" Imperial Audience Hall (大極殿), and the "Touinteien" East Palace Garden (東院庭園), which have been recognized by UNESCO as world cultural heritage buildings.

4. International Conventions and Japanese Conservation Theory

4.1. The 1964 Venice Charter

The 1964 Venice Charter [12] (the "Venice Charter"), which was adopted by ICOMOS in 1965, consists of 16 articles that mention the domains of definitions (article 1 to article 3), conservation (article 4 to article 8), restoration (article 9 to article 13), historic sites (article 14), excavation (article 15), and publication (article 16). In this discussion, the concepts of original material and authentic documents mentioned in article 11 are focused on comparing the concepts of values and authenticity with the subsequently mentioned 1994 Nara Documents on Authenticity.

The unifying characteristic of the wooden architectural heritage of Asian countries is the creation of structures from a variety of timbers using specific tenon-jointing techniques. In addition to forced changes, due to human repair and renovation activities, wooden structures also show their own changes due to external factors that affect them and the unavoidable effects of material decomposition. Therefore, the requirement to repair and replace decayed wooden timbers is a force majeure activity that is necessary to maintain the existence of heritage buildings. Accordingly, if architectural heritage is recognized as a living entity, all the above changes or replacements are considered to be elements constituting the value of the heritage site in question.

Article 11 states: "The valid contributions of all periods to the building of a monument must be respected since unity of style is not the aim of a restoration". Article 9 states: "The process of restoration is a highly specialized operation. Its aim is to preserve and reveal the aesthetic and historic value of the monument and is based on respect for original material and authentic documents". Accordingly, it is particularly important to preserve the original material and to keep authentic documents demonstrating the site's heritage value; therefore, the restoration work must aim to achieve integrity in the preservation of all value, including the changes made to the heritage site in the past.

However, the above-mentioned charters seem inadequate and difficult to apply thoroughly to wooden structures that are often sensitive to weather conditions and often have shorter lifespans than brick and stone structures. Therefore, in the case of the Venice Charter as it applies to wooden heritage buildings, of which Japan is one of the countries possessing many types, the requirements must be based on the specific characteristics of the heritage site according to a specific interpretation. Specifically, a "change" that has been made to brick and stone structures is understood to be the addition of a new part or a new layer of plaster, while in the case of Japanese wooden heritage buildings, it is the "replacement" of decayed timbers with new ones in their original positions and with their original function, or the replacement of part of the timber if there is a need for consolidation (Figure 38). This confusion has led Japanese conservation experts to build a new conceptual connotation based on the term "authentic" employed in the Venice Charter. On the one hand, this will serve to improve the contents of the Venice Charter, and on the other hand, this will expand the conceptual connotation to suit the condition and nature of Japanese wooden heritage buildings.

Figure 38. Replacement of decayed timbers with new ones in their original positions and with their original function, conserving the original components by using traditional jointing techniques and saving the historical information written in ink on the wood (Nara, 2004).

Obviously, "originality" includes "authenticity", but "authenticity" does not necessarily imply the value of "originality". For example, if column A is identified as a first-made original component in its original position, column A also has authenticity. Whenever column A decays, the material goes through an irresistible period of decomposition and cannot continue to perform the same weight-bearing function as before, forcing people to replace it with a new column. If the new column B is made in the same way as the orig-

inal column A (the same wood species and physicochemical properties, the same design method, the same carpenters' tools, the same techniques, and the same function, form, and decorations), then column B achieves the same authentic value as column A (although it is not an original one). However, when the same procedure is repeated by using column C to replace column B, then column C also possesses authentic value. With the characteristics of natural wood materials and using the above-mentioned logic, column A can decompose and disappear, and, if the replacement of column B in the original position of column A, or the movement of column C into the position of column B is due to force majeure, then columns B and C will at some time point in the future be equivalent in authenticity to column A, but they do not contain originality. Thus, "originality" and "authenticity" have to be distinguished.

The "authentic" concept, as in the above-mentioned article 11 of the Venice Charter, can be understood in a way that is too broad or, conversely, too narrow within the limits of the literature. Therefore, in article 9 of the 1994 Nara Documents on Authenticity (the "Nara Document"), this concept has been emphasized and concretized: *"Conservation of cultural heritage in all its forms and historical periods is rooted in the values attributed to the heritage. Our ability to understand these values depends, in part, on the degree to which information sources about these values may be understood as credible or truthful. Knowledge and understanding of these sources of information, in relation to original and subsequent characteristics of the cultural heritage and their meaning, is a requisite basis for assessing all aspects of authenticity"*.

However, with the valuable attribute of heritage as a living entity, the above concept is not comprehensive enough. Therefore, in article 13 of the Nara Document, that concept has been further expanded: *"Depending on the nature of the cultural heritage, its cultural context, and its evolution through time, authenticity judgments may be linked to the worth of a great variety of sources of information. Aspects of the sources may include form and design, materials and substance, use and function, traditions and techniques, location and setting, spirit and feeling, and other internal and external factors"*. Thus, the Nara Document is not only applicable to Japanese wooden heritage buildings but can also be effectively applied to various types of wooden heritage buildings in other countries.

Using such basic arguments, Japanese conservation experts have developed an applicable conservation theory for wooden architectural heritage. Thus, besides preserving the original elements, it is also important to preserve traditional design methods and technologies so that sites can maintain their authenticity and further re-create authentic value. This Japanese conservation style is characterized as "always renewable and always authentic".

4.2. Regarding the 1994 Nara Document on Authenticity

The Nara Document [13] was drafted by the 45 participants at the Nara Conference on Authenticity at the World Heritage Convention held at Nara, Japan, from 1–6 November 1994. The Nara Document consists of 13 articles and 2 appendices, in which the additional concepts of cultural diversity and heritage diversity (articles 5, 6, 7, and 8) and values and authenticity (articles 9, 10, 11, 12, and 13) are conceived in the spirit of the Venice Charter. Accordingly, it is good to see that the Nara Document has simultaneously implemented two important theoretical items that expand core concepts in the conservation of cultural heritage worldwide.

4.2.1. Cultural Diversity and Heritage Diversity

Dialectically, heritage diversity is an inevitable consequence of cultural diversity, consistent with UNESCO's basic principle: *"The cultural heritage of each is the cultural heritage of all"* (Nara Document, article 8). Therefore, *"The diversity of cultures and heritage in our world is an irreplaceable source of spiritual and intellectual richness for all humankind. The protection and enhancement of cultural and heritage diversity in our world should be actively promoted as an essential aspect of human development"* (Nara Document, article 5).

Accordingly, the development of each ethnic community cannot but rely on each nation's traditional inheritance. The diversity of heritage will both enrich and ensure a source

of fresh cultural genes, from which each ethnic community can develop sustainably. The concepts of cultural diversity and heritage diversity mentioned in the Nara Document have broadened the heritage identification framework, from which a variety of traditional architecture and indigenous buildings that have been generated by initiative acculturation with others through history can represent candidates for national cultural heritage or world cultural heritage.

4.2.2. Values and Authenticity

Formally speaking, cultural heritage includes the following groups of values [14].

(a) Emotional values include wonder, identity, continuity of tradition, admiration, reverence, symbolism, and spirit.
(b) Cultural values include documentary, historical, archaeological, and chronological values, aesthetics and architecture, landscape, ecology, science, and technology.
(c) Future usage values include functional, economic, social, educational, and political values.

These groups of values are appraised or recognized after heritage has been generated or recognized; these are also the evaluation criteria used in recognition of the ranks and types of cultural heritage.

The Nara Document clarifies the origin of these values through the concept of heritage's constitutive values, including their whole aspects, to create those values of the heritage. As it clearly expresses: *"Cultural heritage diversity exists in time and space, and demands respect for other cultures and all aspects of their belief systems"* (Nara Document, article 6). In addition: *"Conservation of cultural heritage in all its forms and historical periods is rooted in the values attributed to the heritage"* (Nara Document, article 9). Thus, it can be considered that before the heritage and its values were generated, there existed the germ of the latent heritage shape within the traditions of the ethnic community that produced it. Perhaps this is a bold and completely valid conceptual proposition derived from the tradition and reality of the conservation of Japanese cultural heritage; its scope is not limited to the framework of the administrative boundaries of Japan but can also transcend space and time to spread to many other countries that own wooden heritage buildings.

The concept of authentic documentation was mentioned for the first time in the Venice Charter, but this is limited in terms of the framework of documents proving the original trustable information of the heritage for restoration activities, which *"aims to preserve and reveal the aesthetic and historic value of the monument based on respect for original material and authentic documents"* (Venice Charter, article 9). However, the authenticity mentioned in the Nara Document is of concern: *"Depending on the nature of the cultural heritage, its cultural context, and its evolution through time, authenticity judgments may be linked to the worth of a great variety of sources of information. Aspects of sources may include form and design, materials and substance, use and function, traditions and techniques, location and setting, spirit and feeling, and other internal and external factors"* (Nara Document, article 13).

In addition, a monument in the shape of a building is an architectural entity consisting of a combination of original objects that cannot be reproduced. Heritage in the shape of a wooden building is a wooden heritage building that is able to be physically reconstructed by continuing to not hybridize its source of genetics in case of its destruction. Thus, a monument is a unique prototype, while a wooden heritage building can be an "N" version of that original prototype that can be regenerated during its use throughout history. In the case of the relocated Yakushiji Pagoda (718) in Nara, the reconstruction of the West Pagoda (in 1980) based on its source of genetics referenced the design of the East Pagoda (the original one dates back to the 8th century). Perhaps this is a typical example of this connotation (Figures 39–41). In addition, the Japanese reconstruction methodology has been applied suitably in the case of a reconstruction study of the Can Chanh Dien Main Palace (勤政殿) in Hue Imperial City, Vietnam [15].

In a word, what Japanese conservation experts want to present, through theory and practice, regarding the conservation of wooden architectural heritage is a situation like the cloning of "Dolly the sheep" in the field of biology, which would provide a way to open

up an international legal basis for the restoration and reconstruction of valuable wooden architectural heritage that was lost in the past, a typical case being the Nara Palace site.

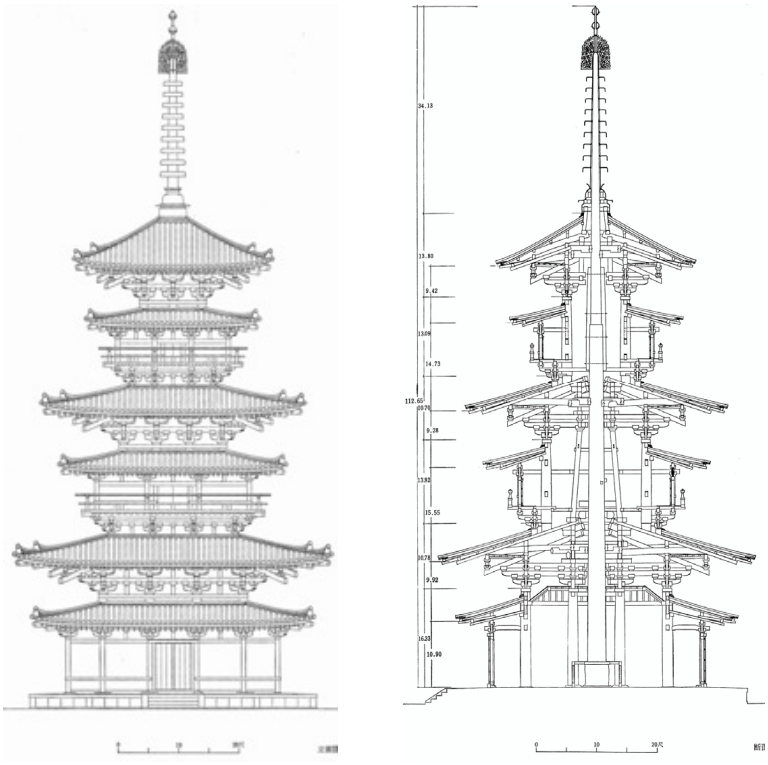

Figure 39. Elevation and section drawings of the East Pagoda, which was used to create the Yakushiji Pagoda (source: the Laboratory of the History of Architecture, Waseda University, Tokyo, Japan).

Figure 40. The East Pagoda (source: https://yakushiji.or.jp (accessed on 20 December 2023)).

Figure 41. The West Pagoda (source: https://yakushiji.or.jp (accessed on 18 December 2023)).

Authenticity, according to the Nara Document, "… appears as the essential qualifying factor concerning values. The understanding of authenticity plays a fundamental role in all scientific studies of cultural heritage, in conservation, and in restoration planning, as well as within the inscription procedures used for the World Heritage Convention and other cultural heritage inventories" (Nara Document, article 10). Therefore, the connotation of authenticity is very broad (in terms of quantity) and becomes important (in terms of quality), opening up great prospects for the reconstruction of wooden architectural heritage buildings in many other countries. From this beginning, it is possible to propose the concept of so-called "architectural heritage DNA".

5. Discussion of the So-Called "Architectural Heritage DNA"

5.1. Regarding Biology, Genetics, and DNA

"Biology is the scientific study of life, it is a natural science with a broad scope but has several unifying themes that tie it together as a single, coherent field. For instance, all organisms are made up of cells that process hereditary information encoded in genes, which can be transmitted to future generations. Another major theme is evolution, which explains the unity and diversity of life" [16].

"Genetics is the study of genes, genetic variation, and heredity in organisms. It is an important branch of biology because heredity is vital to organisms' evolution. Gregor Mendel, a Moravian Augustinian friar working in the 19th century in Brno, was the first to study genetics scientifically. Mendel studied trait inheritance, patterns in the way traits are handed down from parents to offspring over time. He observed that organisms (pea plants) inherit traits by way of discrete units of inheritance. This term, still used today, is a somewhat ambiguous definition of what is referred to as a Gene" [17].

The deoxyribonucleic acid shortcut called DNA "… is a polymer composed of two polynucleotide chains that coil around each other to form a double helix. The polymer carries genetic instructions for the development, functioning, growth, and reproduction of all known organisms and many viruses" [18]. These references discuss the great scientific discoveries that have helped humans to understand their biological structure.

5.2. What Does the Phrase "Architectural Heritage DNA" Mean?

Naturally, genetic transmission is the instinct of all life, in which unconscious transmission guarantees the evolution of biological lives, while conscious transmission ensures the development of social lives. The above-mentioned phrase references areas of in-depth expertise related to the unconscious transmission of all life, which is self-generable depending on the natural–biological environment. To extrapolate, is this conservation of cultural heritage a kind of conscious transmission of culture and civilization that is regenerable, depending on the social environment and human efforts? If so, through this study, the author tries to borrow the concept of naturally existing unconscious transmission to express the development of conscious transmission in the field of architectural heritage conservation. This needs to be continuously conducted, based on the proposed concept of so-called "architectural heritage DNA".

The above-mentioned concept behind the cloning of "Dolly the sheep" in biology can be applied to the case of the reconstruction of the West Pagoda (in 1980), based on its sourcing of a genetic pattern and form that was referenced from the design of the East Pagoda. Genetics in biology is related to unconscious transmission, while the proposed architectural heritage DNA would be conscious transmission, applied in the field of architectural heritage conservation to encourage its regeneration and ensure cultural development. This approach must be followed by humans to ensure the long-term benefit of mankind.

The issue of forgetting mirrors a terminal illness in human beings within their current incarnation; therefore, sometimes human beings forget what they have done in the past and do not know how to repeat their previous actions, such as when cultural heritage is destroyed by wars, natural disasters, and even loss due to unconscious forgetfulness. Thus, the conservation of architectural heritage DNA in both its tangible and intangible aspects represents a way to preserve the memory of human beings and to remind them of their origins, separated by their cultural identity. Architectural heritage DNA can help humans to learn from experience and to ensure their evolutionary progress, both physically and mentally. Thus, in this study, the authors would like to offer the potential structure of the architectural heritage DNA given below.

5.3. Potential Structure of the Architectural Heritage DNA

Following the pattern of the above-mentioned biological DNA, characterized by the "two polynucleotide chains" and "four nitrogen-containing nucleobases", this is possibly a somewhat lame application of the concept of cultural DNA; however, as the first stage of the process, we try to propose the potential structure of architectural heritage DNA, based on the characteristics of architectural heritage resources, which can be explained as follows.

- Resource A references the tangible chains, including:
  - (1) Documentary evidence of the heritage building, including historical documents, the remaining historical reference sources, and archaeological evidence.
  - (2) Authentic building materials, architectural patterns, architectural form, structure, and maintainability.
- Resource B implied the intangible chains, including:
  - (3) Traditional design principles, design methods, and a thorough understanding of traditional construction techniques.
  - (4) The integrity and continuity of traditional techniques associated with traditional craftsmanship, and their applicability to the reconstruction of heritage buildings.

These two resources of A and B, like the "two polynucleotide chains" of biological DNA, represent the two tangible and intangible aspects (negative and positive, or/and yin and yang) of heritage resources, which are intertwined, opposite but not mutually exclusive, and mutually supportive.

In a close-up approach, resources (1), (2), (3), and (4) can be thought of as "four nitrogen-containing nucleobases" that can be combined in forward, reverse, and diagonal directions and work together in pairs, thereby making it possible to create the self-internal

regeneration of architectural heritage DNA in the context of being socialized. Resources (1) and (2) are tangible elements, so they are often understandable and are authenticated within the scope of the conservation major. Resources (3) and (4) are intangible elements that are often non-understandable and are difficult to validate scientifically because they are often influenced by tradition, society, culture, history, and economy. The ideal case, A/B or B/A = 1, is that both the tangible and intangible aspects of heritage resources are balanced so that the conservation of architectural heritage reaches the maximum authentic value (100%). The case with A/B or B/A < 1 is that the authentic value is not guaranteed and needs to be re-evaluated.

Cultural heritage is a sustainable source of genes that strengthen and regenerate cultural identity. In terms of the conservation of architectural heritage, the potentially established architectural heritage DNA will help restoration and reconstruction activities reach their goal of authenticity and/or high-quality conservation. Economically, this conservation achievement will attract goodwill and restore community admiration and reverence for humanity's cultural achievements through heritage, and, as a result, the tourism economy will flourish. To successfully conserve the cultural genetics of each ethnic community, it is necessary that architectural heritage DNA needs to be regenerated for the further future development of each country and of the international community.

6. Assuming the Core Concepts of Architectural Heritage Conservation

6.1. Conservation, Restoration, and Reconstruction

In this discussion about the conservation of architectural heritage, it is impossible not to mention the 1999 Burra Charter [19] (the "Burra Charter"). This Charter provides specific guidance for conserving and managing cultural heritage sites, based on the basic contents of the Venice Charter. The conceptual categories mentioned throughout this paper include conservation, restoration, and reconstruction, the target audience of which is architectural heritage.

Accordingly, "*Restoration and reconstruction should reveal culturally significant aspects of the place*" (Burra Charter, article 18), and "*Restoration is appropriate only if there is sufficient evidence of an earlier state of the fabric"* (Burra Charter, article 19). Meanwhile, *"Reconstruction is appropriate only where a place is incomplete through damage or alteration, and only where there is sufficient evidence to reproduce an earlier state of the fabric. In rare cases, reconstruction may also be appropriate as part of a use or practice that retains the cultural significance of the place*" (Burra Charter, article 20.1), and "*Reconstruction should be identifiable on close inspection or through additional interpretation*" (Burra Charter, article 20.2). Thus, heritage buildings can be rebuilt via new construction to replace that which was lost, following the exact form, materials, and details as used in its original form [20].

With the above-mentioned theory and practice of Japanese approaches to the conservation of architectural heritage and a doctrinal awareness of the international conventions, we try to interpret the concepts as follows:

- Conservation is a way of accumulating heritage to enrich the cultural heritage of each country and the world.
- Restoration is a way to increase bearing capacity, recognize heritage values, and give back that heritage's authentic value.
- Reconstruction is a way of reading and understanding heritage in order to regenerate its source of DNA for the sustainable conservation of that heritage.

Thus, conservation would be the mother concept of restoration and reconstruction. The conservation of architectural heritage is not only about keeping physical heritage buildings but also preserving all that is related to their existence. If an architectural monument is a tangible property, one that is unique and non-renewable, then architectural heritage is a type of cultural property that includes both tangible and intangible constituent elements, which are applicable for regeneration. Tangible constituent elements are understood by their existence, including their design drawings, while intangible constituent elements include the design idea and truthful understanding of them, based on authentic documentation.

6.2. Conservation, Inheritance, and Development

In terms of semantic content, heritage represents property to be left for the next generation, and inheritance is the continuation of that heritage. In the context of this discussion, the continuity of tradition and the integrity of the heritage's constituting value always play a decisive role in the appraisal of heritage values.

Effectiveness is simply a calculated subtraction, wherein what is subtracted but is left behind with usefulness and validity is what we need to conserve, inherit, and use as the foundation for sustainable development. Therefore, conservation, inheritance, and development should be grouped into an indispensable unified logic. Non-selective conservation will be messy, supporting development without the inheritance tradition of each country, or sometimes borrowing or parodying a pattern language and form of language from somewhere else as a fashion trend; this is a development that lacks roots and is unsustainable. Thus, inheritance is an essential bridge between conservation and development. How to effectively inherit the elite results brought by the conservation of cultural heritage is still a difficult issue that each community has to think about and find a suitable way to address this issue by themselves, or perhaps there will be a smart guideline for addressing this issue that has been provided by international experts.

7. Conclusions

Cultural heritage includes both tangible and intangible constituent elements that are closely and sustainably linked together in the form of images, with shadows of things and of phenomena. Therefore, conserving architectural heritage is not only about keeping their physical existence but also conserving all the information related to them.

From the core concepts of international conventions such as the 1964 Venice Charter, the 1994 Nara Documents on Authenticity, the 1999 Burra Charter, and the conservation practices in the Nara Palace site, this study has summarized conservation theories and proposed the concept of "architectural heritage DNA", which includes DNA resource A for implied tangible values and DNA resource B for implied intangible values. Both have to be kept in balance in the conservation of architectural heritage in a manner that helps to keep the maximum "originality" and "authenticity". In addition, this potentially means that restoration is a way to recognize heritage values and give back that heritage's authentic value, while reconstruction is a way of reading and understanding heritage to regenerate its source of DNA, and conservation is a way of accumulating heritage to enrich each ethnic community and the world's cultural heritage. Thus, the concepts of Conservation—Inheritance—Development are always linked together, in terms of heritage preservation.

Cultural heritage is a sustainable source of DNA that strengthens and regenerates cultural identity, and its conservation is a way of conscious transmission to ensure cultural development. In terms of the conservation of architectural heritage, "architectural heritage DNA" will help restoration and reconstruction practices to reach their goals of authentic value and high-quality conservation. Economically, conservation achievements will attract goodwill and restore community admiration and a reverence for humanity's cultural achievements through heritage, as a result of which, the tourism economy will flourish. To successfully conserve the cultural genetics of each ethnic community, it is necessary that "architectural heritage DNA" needs to be assumed and regenerated for the further cultural development of each country.

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